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Self-efficacy for physical activity and insight into its benefits are modifiable factors associated with physical activity in people with COPD: a mixed-methods study

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Questions: What are the perceived reasons for people with chronic obstructive pulmonary disease (COPD) to be physically active or sedentary? Are those reasons related to the actual measured level of physical activity? **Design**: A mixed-methods study combining qualitative and quantitative approaches. **Participants**: People with mild to very severe COPD. **Outcome measures**: Participants underwent a semi-structured interview and physical activity was measured by a triaxial accelerometer worn for one week. **Results**: Of 118 enrolled, 115 participants (68% male, mean age 65 years, mean FEV_1 57 % predicted, mean modified Medical Research Council dyspnoea score 1.4) completed the study. The most frequently reported reason to be physically active was health benefits, followed by enjoyment, continuation of an active lifestyle from the past, and functional reasons. The most frequently reported reason to be sedentary was the weather, followed by health problems, and lack of intrinsic motivation. Mean steps per day ranged between 236 and 18 433 steps. A high physical activity level was related to enjoyment and self-efficacy for physical activity. A low physical activity level was related to the weather influencing health, financial constraints, health and shame. **Conclusion**: We identified important facilitators to being physically active and barriers that could be amenable to change. Furthermore, we distinguished three important potential strategies for increasing physical activity in sedentary people with COPD, namely reducing barriers and increasing insight into health benefits, tailoring type of activity, and improvement of self-efficacy. **[Hartman JE, ten Hacken NHT, Boezen HM, de Greef MHG (2013) Self-efficacy for physical activity and insight into its benefits are modifiable factors associated with physical activity in people with COPD: a mixed-methods study. *Journal of Physiotherapy* 59: 117–124]**

Keywords: Chronic Obstructive Pulmonary Disease, Interview, Physical activity, Sedentary lifestyle, Self-efficacy

Introduction

Regular physical activity has many health benefits for the general population including people with chronic obstructive pulmonary disease (COPD) (Warburton et al 2006). Although COPD is a chronic progressive disease, regular physical activity improves exercise capacity and muscle function, and decreases feelings of fatigue and dyspnoea (Pedersen and Saltin 2006). These benefits may increase the independence of people with COPD and improve their quality of life. Furthermore, physical activity has been shown to be an independent predictor of mortality in COPD (Garcia-Rio et al 2012, Waschki et al 2011). Despite the observed beneficial health effects of regular physical activity for people with COPD, their physical activity levels appear to be low (Bossenbroek et al 2011).

It is important to increase the physical activity levels of people with COPD, and this requires an understanding of its determinants. Several studies found significant associations between physical activity and lung function, dyspnoea severity, exercise capacity, muscle function, comorbid conditions, systemic inflammation, self-efficacy for physical activity, and health-related quality of life (Hartman et al 2010). These associations may lead us to conclude that the main focus is on physical determinants, leaving the potentially large role of psychosocial or behavioural determinants neglected (Sherwood and Jeffery 2000). However, it also has been shown that improving these features by following a pulmonary rehabilitation program does not automatically lead to a higher physical activity level (Troosters et al 2010). Therefore it is important to also consider perceived determinants of physical activity in this population.

What is already known on this topic: Habitual physical activity levels tend to be low among people with COPD. Many physical factors are associated with low physical activity levels in this population, such as dyspnoea, exercise capacity, and comorbidities. However, reversing these physical factors does not necessarily improve habitual physical activity.

What this study adds: People with COPD perceive that facilitators to be active include the health benefits of physical activity, enjoyment, continuation of an active lifestyle, and functional purposes like gardening or travelling to another location. Perceived barriers include the weather, health problems, and lack of motivation.

Perceived determinants of physical activity levels among people with COPD may be elicited by insight into their thoughts and ideas about physical activity, their perceived reasons to be physically active or sedentary, and the opportunities and barriers to physical activity that they experience. An appropriate method to investigate the reasons to be physically active or sedentary is by performing qualitative research (eg, by means of an interview). Qualitative research can provide a unique insight into individual's perspective and attitudes towards physical activity that cannot be elicited through quantitative methods. Frequently reported reasons to be physically active in the general elderly population are: health concerns, socialisation, facilities, physician encouragement and purposeful activity. Frequently reported reasons to be sedentary are: lack of time, fear of injury, tiredness, lack of discipline, inadequate motivation, boredom, intimidation (afraid to slow others down), poor health, the physical environment, and lack of knowledge and understanding of the relationship between physical activity and health (Costello et al 2011, Reichert et al 2007, Schutzer and Graves 2004). However, to be able to increase the physical activity level in people with COPD particularly, we believe it is necessary to identify COPD-specific reasons to be physically active or sedentary. In the pulmonary rehabilitation setting, some qualitative studies have been performed concerning physical activity maintenance. For example, Hogg et al (2012) identified social support from peers and professionals and confidence as important reasons influencing maintenance after pulmonary rehabilitation. As pulmonary rehabilitation is not accessible for all people with COPD, it would be interesting to also investigate the reasons relevant to physical activity in daily life. Williams et al (2007) found that social integration, independence, and enjoyment were related to walking and other functional physical activities in daily life, but the sample size of this study was small. Furthermore, it would be interesting to investigate whether these personal reasons relate to the individual's physical activity level. If barriers are identified that are amenable to change, then this might provide useful information about how physical activity participation could be enhanced in people with COPD.

The research questions addressed in this study were:

1. Among people with COPD, what reasons are perceived as influencing whether they are physically active or sedentary?
2. Are those reasons related to the actual measured level of physical activity?

Method

Design

This observational study combined a qualitative and quantitative approach.

Participants

People with mild to very severe COPD were invited to participate in this study via a letter from their general practitioner or respiratory physician at outpatient clinics of general hospitals in the northern part of The Netherlands. This study was part of a larger study on physical activity in people with COPD. Participants were enrolled in this cross-sectional study between February 2009 and February 2012 if they had COPD according to the GOLD criteria (Vestbo et al 2012). Comorbidities were allowed, but people were excluded if they had serious active disease that needed medical treatment (eg, recent myocardial infarct, carcinoma), or if they were treated for an exacerbation of their COPD during the previous two months.

Box 1. Topic list and initiating questions for the interviews.

History of physical activity

What kind of physical activities have you undertaken in the past?

Motivation to be physically active

What are the reasons for you to be physically active?

Motivation to be physically inactive

What are the reasons for you to be physically inactive?

Experiences with physical activity

How does it feel for you to be physically active?

Cognitions about physical activity

Do you feel that you benefit from being physically active?

Self-efficacy for physical activity

Do you feel confident in your ability to perform the physical activities you intend to do?

Opportunities and barriers to become physically active

Do you experience specific opportunities in becoming physically active?

Do you experience specific barriers in becoming physically active?

Social support for physical activity

Do you experience support for physical activity? For example, support from family, friends, physician or physical therapist?

Preferred type of activity

Do you prefer performing a certain type of physical activity?

Data collection

Interview: All participants were interviewed at home for approximately one hour by one trained interviewer (JH). The interviews were semi-structured; a framework of themes related to physical activity guided the interviewer. The framework of themes was based on potential topics identified in the literature and finalised after discussion with medical experts and two pilot interviews with people with COPD. The topic list of the interviews is presented in Box 1. Interview questions in this framework guided the interviewer but unanticipated themes were allowed. The interviewer made notes during the interview and wrote them up fully directly after.

Physical activity: Physical activity was measured with a triaxial accelerometer[a]. Participants were instructed to wear the small device around their waist continuously for one week, except during showering and swimming. The device is able to detect types of activity (lying, sitting, standing, shuffling, and locomotion) and to measure steps and energy expenditure. It has been shown to be an accurate instrument to measure postures and gait in older adults and people with COPD (Dijkstra et al 2010, Langer et al 2009).

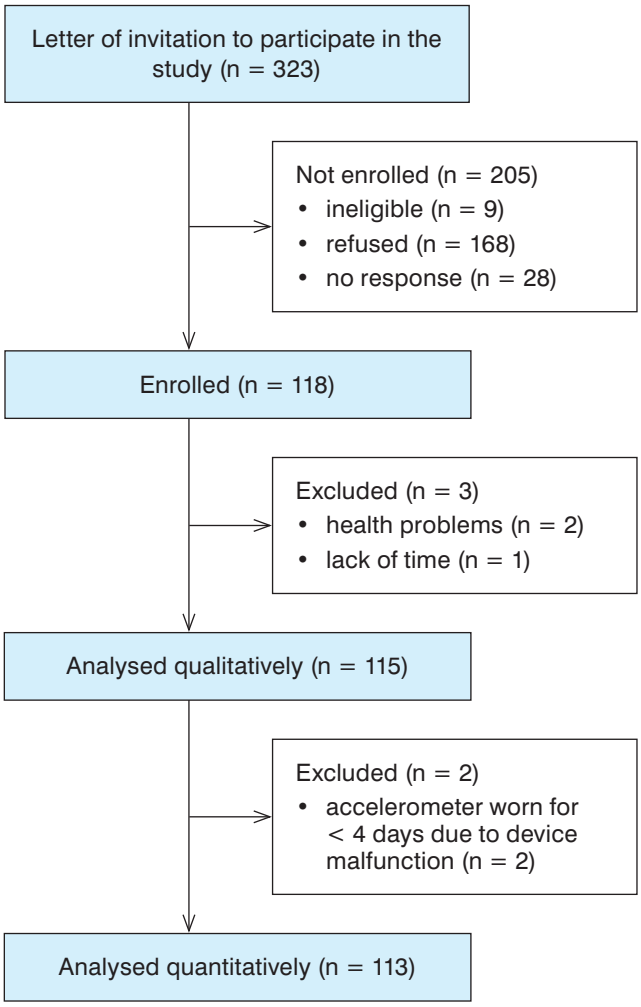

Figure 1. Flow of participants through the study.

Other measurements: Forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) were measured by trained lung function technicians with a spirometer[b] according to European Respiratory Society/American Thoracic Society guidelines (Miller et al 2005). Dyspnoea severity was determined by the modified Medical Research Council dyspnoea index (Bestall et al 1999). Exercise capacity was measured with the 6-minute walk test (ATS 2002). Two 6-minute walk tests with at least one hour in between were performed to account for a training effect and the higher score was used in the analyses.

All measurements were performed over three study visits. At Visit 1, participants were interviewed at home. During Visit 2 at the hospital, lung function was measured and the accelerometer was explained. Participants wore the accelerometer after this visit for one week. During Visit 3 at the hospital, the accelerometer was collected and dyspnoea level and exercise capacity were measured.

Data analysis

Qualitative analysis: Responses during the interviews were coded into categories using the inductive content analysis approach. The aim of this qualitative research technique is to attain a condensed and broad description of a phenomenon (Elo and Kyngas 2008). The outcome of the inductive content analysis is categories describing the investigated phenomenon. The approach includes an iterative process of open coding, creating categories and abstraction (Elo and Kyngas 2008). Each interview transcript was read several times, and afterwards keywords in the text were labelled with codes and grouped into similar concepts, after which categories were formed. To increase consensus, the coding process was performed separately by two trained investigators (JH and MG) with the results compared and discussed afterwards. Disagreements were resolved through discussion with the other authors. The investigators did not have any information on the measured physical activity level of the participants during the qualitative analysis.

Quantitative analysis: We combined the qualitative analysis with a quantitative analysis so as to assess the relationship between the perceived reasons to be sedentary or active and the measured physical activity level. In order to assess whether any relationship exists between the qualitatively obtained categories and the objectively measured physical activity level, a k-means cluster analysis was performed. Cluster analysis is a descriptive statistical method that attempts to identify relatively homogeneous groups of people based on their characteristics. All categories obtained from the interview were entered in the cluster analysis together with the measured physical activity level (mean steps per day).

Results

Flow of participants

The flow of participants through the study is presented in Figure 1. In total 118 people with COPD were willing to participate, provided informed consent, and met the eligibility criteria of the study. Three participants dropped out during the study due to lack of time or health problems. Therefore 115 participants were interviewed and performed all other measurements and were included in the qualitative analysis. Two participants wore the accelerometer less than 4 days due to mechanical problems with the accelerometer and therefore 113 participants were included in the k-means cluster analysis.

The participants' characteristics are shown in Table 1. Participants were predominantly male (68%), with mild to very severe COPD, and with a mean MMRC dyspnoea score of 1.4. Participants walked a median of 5552 steps per day. Among the participants, 28% reported that they should be more physically active, 47% reported that they were sufficiently active, and 25% reported that they were not able to be more physically active due to health problems.

Based on the coding analysis, several categories were distinguished (Box 2). The topics of the categories were: reasons to be physically active, reasons to be sedentary, history of physical activity, subjective experience on physical activity, barriers to become physically active and the influence of social support and stress on physical activity. The reasons to be physically active could be categorised into four categories. The most frequently reported reason to be physically active was for the health benefits (reported by 65% of the participants), followed by enjoyment (44%), continuation of an active lifestyle in the past (28%), and functional reasons (26%). An example of a reported functional reason is that physical activity is necessary for certain daily life activities, like transportation or gardening.

Table 1. Characteristics of the participants.

Characteristic	Participants (n = 115)
Age *(yr)*, mean (SD)	65 (9)
Gender, n male *(%)*	78 (68)
GOLD stage, n *(%)*	
I	30 (26)
II	31 (27)
III	33 (29)
IV	21 (18)
FEV_1 *(% predicted)*, mean (SD)	58 (28)
Living alone, n (%)	30 (26)
Employed, n (%)	13 (11)
BMI *(kg/m²)*, mean (SD)	25.1 (4.0)
6MWD *(m)*, mean (SD)	437 (118)
MMRC Dyspnoea Scale *(0 to 4)*, mean (SD)	1.4 (1.2)
Physical activity[a] *(steps per day)*, median (IQR)	5552 (3557 to 7927)
Lying and sitting[a] *(% of day)*, mean (SD)	80 (7)

[a]n = 113, measured by accelerometer. GOLD = Global Initiative for Chronic Obstructive Lung Disease, FEV_1 = forced expiratory volume in 1 second, BMI = body mass index, 6MWD = 6-minute walk distance, MMRC = modified Medical Research Council

The reasons to be sedentary could be grouped into three categories and there were 18 responses that did not fit into a category. (See Appendix 1 on the eAddenda for details of these isolated responses.) The most frequently reported reason to be sedentary was poor weather (48%), followed by health problems (43%) and lack of intrinsic motivation (11%). In addition 20% of the participants reported having no reason to be sedentary. On average, participants reported 1.7 (range 1 to 4) reasons to be physically active and 1.2 (range 0 to 3) reasons to be sedentary. Self-efficacy for physical activity was explored during a conversation with the participant about whether he/she felt confident in the ability to perform the physical activities he/she executes. If a participant reported confidence this was categorised as 'high self-efficacy'. Positive social support for physical activity was reported by almost 50% of the study population. This included social support from spouse, exercise group/partner, clinician, family and friends. However, only a small group of participants (19%) felt that the social support they experienced also positively influenced their physical activity level.

Figure 2 shows that there is great variability in physical activity preferences. Approximately one-third of the participants preferred going to a health club or performing a sporting activity, while 25% of the participants preferred lifestyle activities, like walking or gardening. Over 40% preferred a combination of both types of physical activity. Additionally, 40% of the participants preferred being physically active with others, 30% alone, and 30% preferred a combination of both. The participants who preferred sports or the health club tended to also prefer being physically

Box 2. Categories distinguished from the interview answers, using an inductive content analysis approach (n = 115).

Topic Response	%
Reasons to be physically active[a]	
health benefits	65
enjoyment	44
continuation of former active lifestyle	28
function	26
History of physical activity	
gymnastics at school	88
sports after age 30 yr	49
physically active in lifestyle activities	48
Subjective experience of physical activity	
pleasant	85
unpleasant	30
none	10
high self-efficacy for physical activity	85
Social support	
positive	47
negative	3
positive and negative	4
none, not applicable	47
Effect of social support on physical activity	
positive	19
negative	1
none	80

[a]Number of reasons reported: one = 47, two = 57, three = 5, four = 6.

Topic Response	%
Reasons to be sedentary[b]	
poor weather	48
health problems	43
lack of intrinsic motivation	11
miscellaneous answers	16
none	20
Barriers to becoming physically active	
weather	75
health	68
weather, health-specific	53
financial constraints	32
not able to pay money	20
not willing to pay money	12
sleep	10
exercise facilities in neighbourhood	7
fear of movement	6
shame	4
time	3
Stress	
positive influence on physical activity	18
negative influence on physical activity	13
none, not applicable	68

[b]Number of reasons reported: zero = 23, one = 54, two = 35, three = 3.

Table 2. K-means cluster analysis (n = 113) showing the two clusters generated and the characteristics that were significantly different between the clusters from those entered into the analysis[a].

Characteristic	Cluster 1 High daily physical activity (n = 52)	Cluster 2 Low daily physical activity (n = 61)	*p*
Physical activity *(steps per day)*, mean (SD)	8807 (2474)	3312 (1549)	< 0.01
Reported reasons to be physically active, (%)			
enjoyment	29 (56)	20 (33)	0.01
Self-efficacy for physical activity	49 (94)	48 (79)	0.02
Reported reasons to be sedentary, (%)			
weather, health specific	20 (38)	40 (66)	< 0.01
financial constraints	6 (12)	30 (49)	< 0.01
health	27 (52)	49 (80)	< 0.01
shame	0 (0)	5 (8)	0.04
Demographics			
Gender, n male (%)	38 (73)	38 (62)	0.23
Age *(yr)*, mean (SD)	66 (8)	64 (9)	0.50
FEV_1 *(% predicted)*, mean (SD)	72 (23)	45 (26)	< 0.01
MMRC Dyspnoea Scale *(0 to 4)*, mean (SD)	0.8 (0.8)	1.9 (1.2)	< 0.01
6MWD *(m)*, mean (SD)	512 (69)	374 (116)	< 0.01

[a]See the main text for details of the variables entered into the cluster analysis. FEV_1 = forced expiratory volume in 1 second, MMRC = modified Medical Research Council, 6MWD = 6-minute walk distance

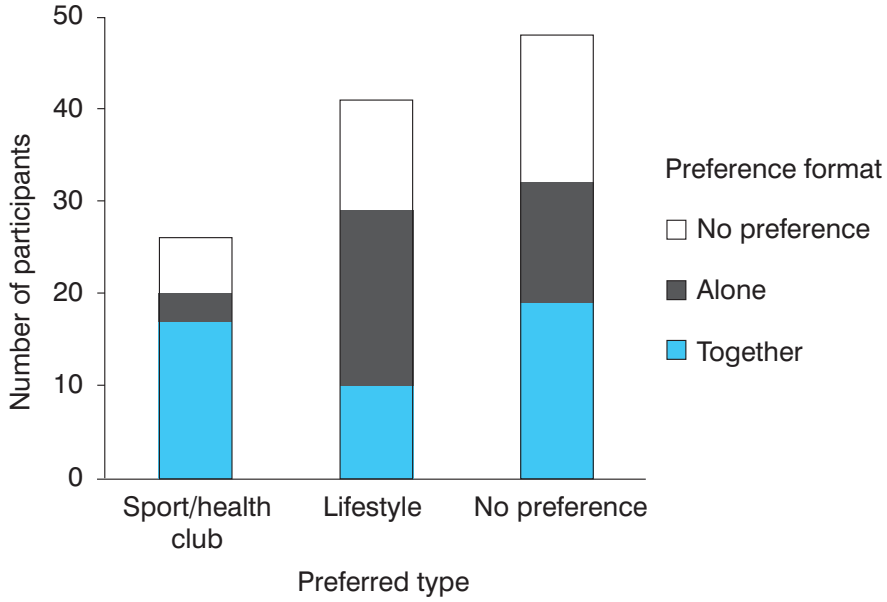

Figure 2. Preferences of participants for specific types and formats for physical activity. For the numerical size of each preference category, see the annotations on Figure 3 on the eAddenda.

active with others, whereas the participants who preferred lifestyle activities tended to also prefer being physically active alone.

Table 2 shows the results of the cluster analysis, which generated two clusters. Although all categories of the interview were entered in the cluster analysis, Table 2 shows only the categories that were significantly different between the clusters that were formed by the cluster analysis. The clusters could be characterised as one cluster with a high physical activity level and one cluster with a low physical activity level. A high physical activity level was related to being physically active because of enjoyment and high self-efficacy for physical activity. A low physical activity level was related to being sedentary because of poor weather influencing health, financial constraints, health problems, and being ashamed to be physically active. We also investigated if the clusters differed in lung function, exercise capacity, dyspnoea severity, gender, or age. The cluster with a high physical activity level was characterised by higher lung function and exercise capacity and less severe dyspnoea than the cluster with low physical activity level. Gender and age did not differ significantly between clusters.

Discussion

The identification of personal perspectives about physical activity is important because it increases our knowledge of the facilitators of and barriers to physical activity in people with COPD. Our results show that the most frequently reported reason to be physically active was health benefits, followed by enjoyment, continuous active lifestyle in the past, and functional reasons. The most frequently reported reason to be sedentary was poor weather, followed by health problems, and lack of intrinsic motivation.

Additionally, we could identify several factors that were related to the actual measured physical activity level. A high physical activity level was related to the following two facilitators: enjoyment and self-efficacy for physical activity. A low physical activity level was related to the following four barriers: weather influencing health, financial constraints, health problems, and shame.

An identified facilitator of physical activity was enjoyment. This is in line with a review that also showed that perceived exercise enjoyment and satisfaction predict higher levels of physical activity and adherence to exercise in two general adult populations (King et al 1992). Another identified facilitator was high self-efficacy for physical activity. Self-efficacy is someone's belief in his/her capability to successfully execute a specific type of behaviour, in this case physical activity (Bandura 1997). High self-efficacy was found to be more present in people with mild to moderate COPD than in those with severe or very severe COPD, and more in males than in females. It is known that self-efficacy is a strong and consistent predictor of exercise adherence and that it is essential for the process of behavioural change (McAuley and Blissmer 2000, Schutzer and Graves 2004, Sherwood and Jeffery 2000). Furthermore, two studies in people with COPD showed that physical activity was positively associated with self-efficacy (Belza et al 2001, Steele et al 2000). This emphasises the importance of enjoyment of physical activity and self-efficacy for physical activity for adherence to a physically active lifestyle.

Another perceived influence on physical activity was the weather, with 75% of participants reporting poor weather as a barrier to being physically active. Mostly, participants reported disease-related complaints caused by different weather types, such as more dyspnoea with high humidity in the air. This is consistent with studies in general adult populations but also COPD populations, showing that weather affects exercise adherence and physical activity levels (O'Shea et al 2007, Sewell et al 2010, Tucker and Gilliland 2007). A second barrier was health problems. Health as a barrier was mainly due to COPD-related complaints like dyspnoea, but also other comorbidities such as joint problems were reported to affect physical activity. Health as a barrier was more frequently reported in people with severe or very severe COPD. Health was also the most frequently reported reason to be physically active. Despite health-related limitations many participants also understood the benefits of regular physical activity for their health. These results are in line with those found in an elderly population (Costello et al 2011). A third barrier was financial constraints – reported by almost a third of participants. The category of financial constraints included not being able to pay and not being willing to pay for physical activity. In general elderly populations, financial constraints are not among the most frequently reported reasons to be sedentary (Costello et al 2011, Reichert et al 2007, Schutzer and Graves 2004). However, in our COPD population it appears to be an important factor. The last barrier was shame. The reasons to feel ashamed, limiting these participants in physical activity, were use of a walking aid and sometimes an oxygen cylinder or having to exercise with healthy people. Participants reporting this barrier all had very severe COPD and were mainly female. In a qualitative study of people with COPD, the exercise facility was also found to be a possible barrier due to feelings of embarrassment or intimidation (Hogg et al 2012). This is similar to a frequently mentioned reason in the general elderly population: intimidation or fear of slowing other people down during physical activities (Costello et al 2011).

Some theories of behavioural change exist and may explain adherence to physical activity. According to those theories, adherence to physical activity seems to be promoted by the presence of individual needs, personal level of fitness, readiness for behavioural change, self-efficacy, and social support (Seefeldt et al 2002). In line with this, we found that individual needs, personal level of fitness and self-efficacy were related to physical activity in people with COPD. Importance of individual needs was reflected by our finding that enjoyment in physical activity is important, as was the high variability in individual preferred type of activity. Readiness for change in behaviour was not a theme of the interview. In contrast with those theories, the influence of social support on physical activity was not clear in our population. Although a large group of participants report positive social support on physical activity, most of these participants do not feel that the experienced social support influences their actual physical activity level. Furthermore, we identified some disease-specific barriers to physical activity in people with COPD that are not specifically present in the behavioural change theories: health, financial constraints, weather, and shame. Additionally, lack of time, a frequently reported reason to be sedentary in the general elderly population, was reported by only three participants in our sample. Consequently, lack of time appears not to be an issue in our population of people with COPD. Furthermore, tiredness or poor sleep quality and fear of movement were not reported frequently as reasons to be sedentary.

This study is unique because of the large heterogeneous population of people with COPD we studied and its combined qualitative and quantitative design. The population included 115 people with COPD in all stages of severity of the disease with a broad spectrum of clinical characteristics, and therefore allows conclusions about the full range of people with COPD. The use of qualitative research methods allowed us to gain more insight into the personal thoughts and ideas about physical activity. The use of two independent trained coders, use of an iterative coding process, and the use of standardised methods strengthen the internal validity of the findings. A limitation of the current study is that due to the relatively high number of participants, the interviews were not audio-taped and transcribed verbatim. Additionally, due to the large sample size we decided not to ask the participants for feedback on the findings, but we did discuss the findings with a respiratory physician (NtH). Furthermore, we also measured physical activity objectively, which allowed us to compare the subjective responses to the actual physical activity level. Due to the cross-sectional design we are not

able to draw definite conclusions regarding possible cause-effect relationships and therefore longitudinal studies are necessary.

The practical implications of our results relate to the development and optimisation of physical activity enhancement strategies in COPD. Three important implications can be distinguished, namely reducing barriers and increasing insight into health benefits, tailoring type of activity, and improvement of self-efficacy.

People with COPD feel that their physical activity level is limited by their health problems, but at the same time are aware of potential benefits of regular physical activity. Frequently, the balance is in favour of feelings of limitation because health as a barrier was related to low physical activity and because benefit awareness was not related to high physical activity. This indicates that one should try to dispel false perceptions about barriers to physical activity first, and then increase insight into the many potential individual health benefits of regular physical activity. In our opinion, removing barriers should not be an educational process only; it should also be achieved with real-life physical activity experiences, eg, with the help of a physiotherapist. In the statement of the American Thoracic Society and European Respiratory Society on pulmonary rehabilitation, the benefits of exercise and maintenance of physical activity are already mentioned as suitable educational topics during a rehabilitation program (Nici et al 2006).

The large variability in types of preferred physical activity between people with COPD suggests that one standardised physical activity program will not be suitable. People with COPD should not be forced to participate in one standard physical activity program, but programs should be discussed and chosen together with the individual. A clinician or physical therapist may discuss all options together with the individual, particularly in those people with a limited activity history, taking potential barriers like financial constraints and embarrassment about exercising with healthy people or with the help of a walking aid into account. Additionally, the possible influences of weather on adherence to regular physical activity should be discussed with the individual. This could include talking about back-up activities in case of poor weather, eg, the possibility of exercising at home. This is also important for transfer to the home setting after a pulmonary rehabilitation program.

Increasing self-efficacy for physical activity means improving the individuals' judgment of their ability to perform certain physical activities. Factors that have been shown to increase self-efficacy and that could be incorporated in physical activity programs are performance experience, vicarious experience (modelling), social persuasion, and decreased physiological and emotional arousal (Bandura 1997). Improving physical activity performance experiences could be accomplished during physical activity programs, for example with help from a physiotherapist. Starting with easy to perform physical exercises will be attractive because people will first experience success instead of failure. During these programs social modelling and social persuasion is important, which could be achieved by group-orientated physical activity programs, physical activity with friends or family, or encouragement of a physician or physiotherapist. Physiological and emotional stresses could be contained by monitoring certain parameters during physical activity like blood oxygen saturation, blood pressure or Borg score, or, if warranted, teaching the individual stress management techniques. Further, this could include teaching people with COPD to distinguish unpleasant from dangerous sensations.

People with COPD perceive a variety of facilitators and barriers to being physically active or sedentary in daily life. We identified three important recommendations for enhancing physical activity in people with COPD. The results could help direct efforts to enhance physical activity in this clinical population with its very high prevalence of physical inactivity. ■

Footnotes: [a]DynaPort, McRoberts, The Netherlands; [b] MasterScreen PFT, Masterscope, Viasys, Germany.

eAddenda: Appendix 1, Figure 3 available at jop.physiotherapy.asn.au

Ethics: The local ethics committee approved this study (University Medical Center Groningen, The Netherlands). All participants gave written informed consent before data collection began.

Competing interests: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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